EXECUTIVE SUMMARY

This report to Congress provides information collected by the U.S. Environmental Protection Agency (EPA) on the types of wastewater discharged from commercial fishing vessels and nonrecreational vessels less than 79 feet in length. The report also provides information on the primary pollutant concentrations in these discharges and the likelihood of any resulting environmental impacts based on rate, frequency, volume, and location discharged. This study was conducted to meet the obligations of EPA under Public Law (P.L.) 110-299 (July 31, 2008). The law provided for a temporary two-year moratorium on National Pollutant Discharge Elimination System (NPDES) permitting of discharges from commercial fishing vessels, regardless of size, and other nonrecreational vessels less than 79 feet long that were subject to the 40 CFR 122.3(a) exclusion. Except for ballast water discharges (evaluated and assessed elsewhere in other Agency reports), discharges from these vessels are not currently covered under the EPA's Vessel General Permit (VGP). During the two-year moratorium, which began July 31, 2008, EPA was required to study the relevant discharges. EPA believes that the results from this study will serve as an objective source of information that Congress can use for statutory decision-making and will provide other readers valuable technical analyses of these vessels' incidental discharges. EPA requested public comment on this draft report in March, 2010: this final report incorporates changes made in response to these comments.

As directed by Congress, the goal of the study was to obtain sufficient information to address the following six core objectives:

- A characterization of the nature, type, and composition of discharges for representative single vessels and for each class of vessel.
- A determination of the volumes of those discharges, including the average volumes for representative single vessels and for each class of vessel.
- A description of the locations, including the more common locations, of the discharges;
- An analysis of the nature and extent of the potential effects of the discharges, including determinations of whether the discharges pose risks to human health, welfare, or the environment, and the nature of those risks.
- A determination of the benefits to human health, welfare, and the environment from reducing, eliminating, controlling, or mitigating the discharges.
- An analysis of the extent to which the discharges are currently subject to regulation under federal law or a binding international obligation of the United States.

EPA designed and conducted a sampling program of discharges from commercial fishing vessels and other nonrecreational vessels less than 79 feet in length to provide information to achieve the first two objectives of the study. As required in P.L. 110-299, the study specifically evaluated the impacts of any 1) discharge of effluent from properly functioning marine engines; 2) discharge of laundry, shower, and galley sink wastes; and 3) other discharges incidental to these vessels' normal operation. In addition, EPA supplemented sample collection and analysis with the collection of contemporaneous information regarding the shipboard processes, equipment, materials, and operations that contribute to the discharges, as well as the discharge rates, duration, frequency, and location.

EPA found that commercial fishing vessels and nonrecreational vessels discharge a wide variety of effluents during their normal operation. The Agency decided to focus its evaluation on discharges from engines, bilges, fish holds, decks, and graywater activities because such discharges can release oils, heavy metals, toxic organics, oxygen-depleting substances, nutrients, and endocrine-disrupting compounds to ambient waters in quantities that may exceed National Recommended Water Quality Criteria (NRWQC). In some circumstances, some of these vessel discharges to water bodies have the potential to impact the aquatic environment.

Vessel Types

EPA estimates there are between 118, 000 and 140,000 vessels in the United States subject to the permitting moratorium (i.e., study vessels).[1] Figure ES. 1 presents the estimated number of study vessels by vessel types (service). Approximately one-half of these vessels are commercial fishing vessels involved in activities such as fish catching (e.g., longliner, shrimper, trawler), fish processing, fishing tending, and charter fishing. The other half is distributed among a variety of vessel classes, including passenger vessels (e.g., water taxis, tour boats, harbor cruise ships, dive boats), utility vessels (e.g., tug/tow boats, research vessels, offshore supply boats), and freight barges.

[1] Based on the U.S. Coast Guard Marine Information for Safety and Law Enforcement (MISLE) database. See discussion in Chapter 1 and Appendix B of this report for detailed discussions about vessel estimates and limitations of these estimates.

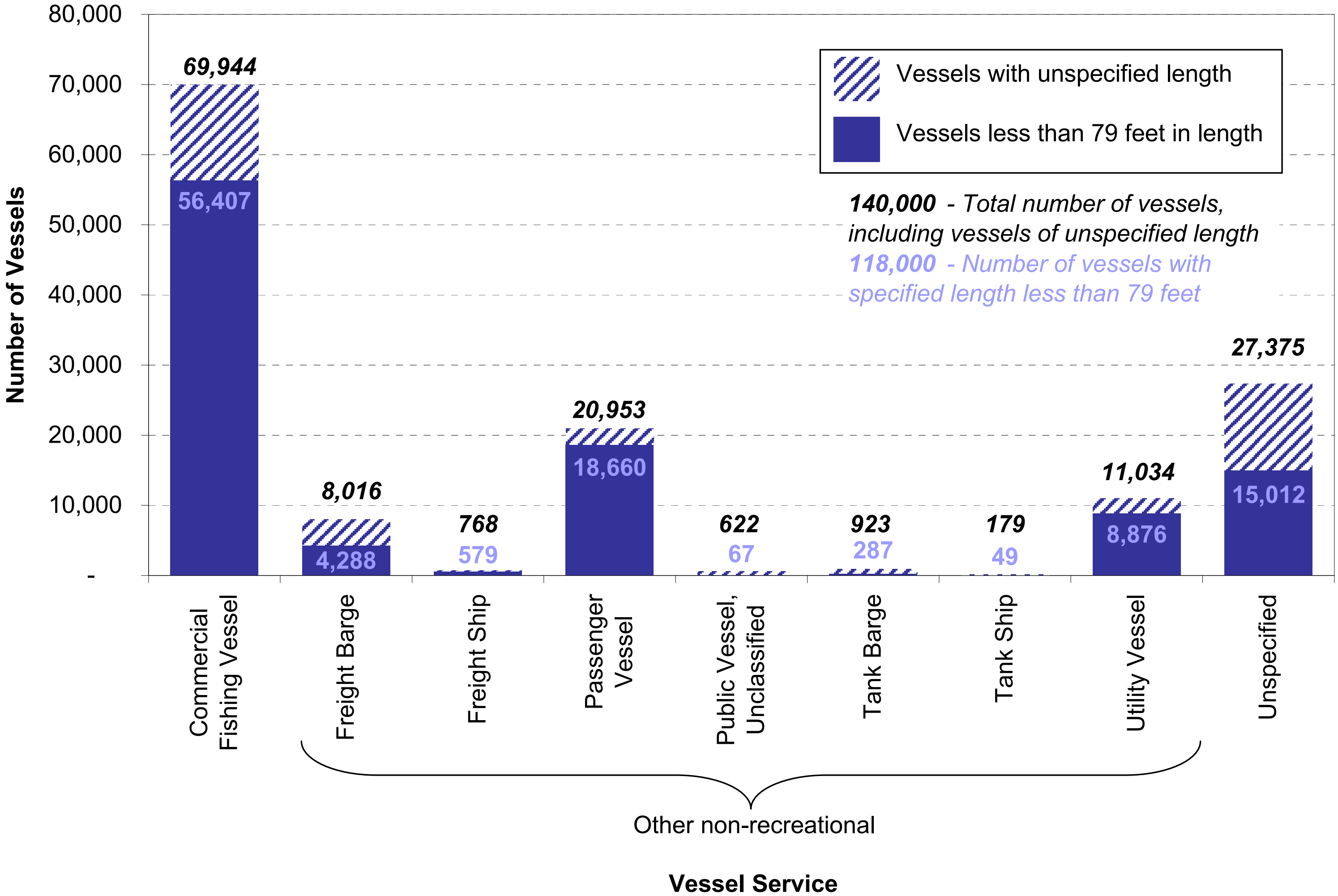

Figure ES.1. Estimated Number of Study Vessels by Vessel Service (Type)

To select specific vessel classes for sampling, EPA first developed a list of commercial vessel classes based on published information and industry experience. Next, due to limited time and resources, EPA eliminated those vessel classes believed to consist primarily of vessels greater than 79 feet in length, with the exception of commercial fishing vessels. Examples of vessel classes eliminated because of their size included cable laying ships, cruise ships, large ferries, and oil and petroleum tankers. Next, EPA eliminated vessel classes that have historically been subject to NPDES permitting, including stationary seafood processing vessels and vessels that can be secured to the ocean floor for mineral or oil exploration. After screening out these vessel classes, EPA selected a subset of priority vessel classes to study, including commercial fishing boats, tug/tow boats, water taxis, tour boats, recreational vessels used for nonrecreational purposes, and industrial support boats less than 79 feet in length. EPA selected these vessel classes because they represent a cross section of discharges and have the potential to release a broad range of pollutants.

EPA sampled wastewater discharges and gathered shipboard process information from 61 vessels in nine vessel classes. Vessels were sampled in 15 separate cities and towns in nine states across multiple geographic regions, including New England, the Mid-Atlantic, the Gulf Coast, the

Mississippi River, and Alaska. Table ES.1 presents the types of vessels from which EPA sampled and gathered shipboard process information for this study. EPA sampled more commercial fishing vessels than any other vessel class due to the large number of fishing vessels subject to the P.L. 110-299 permitting moratorium. EPA also sampled a few recreational vessels used for commercial purposes (e.g, towboats) to: 1) provide a semiquantitative comparison of the discharges from these vessels and the other study vessels, and 2) collect additional information for EPA's related Clean Boating Act (P.L. 110-288) work.

Table ES.1. Vessels Sampled by EPA

Vessel Class	Number of Vessels Sampled
Fishing:	
Gillnetter	5
Lobster Tank	1
Longliner	3
Purse Seiner	5
Shrimp Trawler	6
Tender	3
Trawler	4
Troller	6
Tugboat	9
Water Taxi	4
Tour Boat	3
Tow/Salvage [1]	6
Research [1]	2
Fire Boat	1
Supply Boat	1
Recreational	2
Total	**61**

(1) Consists primarily of recreational vessels used for commercial or governmental purposes.

Sampled Discharges

EPA sampled a total of nine discharge types from the various vessel classes listed above. These included:

- Bilgewater
- Stern tube packing gland effluent
- Deck runoff and/or washdown
- Fish hold effluent (both refrigerated seawater effluent and ice slurry)
- Effluent from the cleaning of fish holds
- Graywater
- Propulsion and generator engine effluent
- Engine dewinterizing effluent
- Firemain

EPA typically sampled one to four discharge types on each vessel, depending on applicability, accessibility, and logistical considerations. Vessel discharge samples were analyzed for a variety of pollutants, including classical pollutants such as biochemical oxygen demand (BOD_5), total suspended solids (TSS), residual chlorine, and oil and grease; nutrients; total and dissolved metals; volatile and semivolatile organic compounds (VOCs and SVOCs); nonylphenols (used as surfactants in detergents), which are endocrine-disrupting compounds; and pathogen indicators (i.e., *E. coli*, enterococci, fecal coliforms).

Summary of Findings

EPA found that the sampled discharges with the greatest potential to impact surface water quality include deck washdown, fish hold effluent, graywater, bilgewater, and marine engine effluent. Though these discharges may have the potential to impact surface water quality, particularly on a localized scale, a screening level model of a hypothetical large harbor indicates that most of these discharges in and of themselves would not cause exceedences of national water quality criteria in large water bodies (see additional discussion under environmental impacts below). Review of available literature also indicates that leachate from antifouling hull coatings used on certain vessels to prevent buildup of organisms, such as barnacles and algae, as well as underwater hull cleaning, likely impact surface water quality in some situations.

Deck washdown from utility vessels such as tug/tow boats, tour boats, water taxis, and supply boats had elevated dissolved and total metal concentrations (e.g., aluminum) likely associated with particulate metal washing off metal decks or decks with significant metal components. Certain deck washdown samples also contained pollutants such as BOD_5, TSS, nonylphenols, total phosphorous, and total residual chlorine, all of which are associated with detergents and disinfectants.

Fish hold effluent, which is either refrigerated seawater or ice slurry water found on fishing boats, had BOD_5 and chemical oxygen demand (COD) concentrations that were several times higher than concentrations typically measured in raw domestic sewage. Nutrient levels in many fish hold effluent samples were also similar to the concentrations normally found in raw domestic sewage, and ammonia nitrogen was occasionally detected at concentrations acutely toxic to aquatic life. While small fishing boats periodically discharge only a few hundred gallons of fish hold wastewater, large fishing vessels, such as offshore trawlers, can discharge thousands of gallons of fish hold wastewater in a matter of minutes.

Most fishing vessel owners also clean the fish hold tanks with a detergent and/or disinfectant after the fish have been off-loaded. Detergents are suspected of containing nonylphenols, which are endocrine-disrupting compounds. Disinfectants such as chlorine bleach contain high concentrations of total residual chlorine, which is toxic to aquatic organisms. The samples of fish hold cleaning effluent contained nonylphenols and total residual chlorine, along with the same pollutants measured in the fish hold effluent.

Galleys, sinks, showers, and laundry facilities onboard commercial vessels generate graywater, which is typically discharged overboard. Graywater volumes vary considerably depending on the class of vessel and its intended use, vessel size, the number of crew and passengers onboard, and the types of graywater-generating activities. Pollutants associated with the various graywater sources depend on a variety of factors, such as the amount of food waste flushed into the graywater system, the level of soiling on clothing being washed in the onboard laundry, and the use of showers. EPA did not sample graywater mixed with sewage, so the results for this study are for graywater only. EPA's sampling data found pathogens to be the primary pollutant of concern in graywater. The sampling data show that at least one of the pathogenic organisms (fecal coliforms, enterococci, and *E. coli*) was found in all graywater samples, and that levels of these indicators in most of these samples exceeded the water quality benchmarks, some by as much as four orders of magnitude.

Bilgewater effluent consists of the water that collects in the bottom of the vessel from sources such as precipitation and spray, fuel spills, leaking sewage and graywater piping, condensates, and deck washing. Bilgewater contained the greatest variety (although not necessarily the highest concentrations) of priority pollutants, including both total and dissolved metals, VOCs, and SVOCs. It also contained pathogenic bacteria, nonylphenols, sulfide, total phosphorous, BOD_5, TSS, and residual chlorine. Both total arsenic and dissolved copper concentrations in bilgewater were consistently above the most conservative screening benchmarks (e.g., EPA's 2006 NRWQC), and total arsenic concentrations were nearly 1,000 times the safe human health standard.

Propulsion and generation engine effluent varied dependent upon the type of engine. EPA found that inboard propulsion engines discharge more pollutants in their cooling water than outboard propulsion engines or generators. EPA also found that VOCs and SVOCs are the primary pollutants of concern found in marine engine cooling water discharges. These pollutants (e.g., benzene and several PAHs, including some that are carcinogenic, or cancer causing) are present in fuels and are products of incomplete combustion. Dissolved copper was also measured in most inboard engine effluents at concentrations that exceed the NRWQC. Some vessel owners in cold climates also add a solution of propylene glycol (antifreeze) to the internal cooling system of inboard engines to protect them from freezing during winter. In spring, the antifreeze solution may be discharged as the cooling system is refilled with ambient water. EPA's sampling data showed that the spent antifreeze solution discharged to surface water contained relatively high levels of metals, which are likely a result of corrosion within the engine's cooling system.

Stern tube packing gland effluent (from tug boats) and firemain discharges (limited to just two tug boats, three tour boats, and a fireboat) contained elevated levels of some metals (e.g., dissolved copper, total aluminum, total arsenic). For both of these discharges (firemain in particular), the effluent samples contained relatively small concentrations of pollutants, most of which could be attributed to the ambient surrounding water predominating the discharge. For example, stern tube systems have a continual drip of ambient water while the shaft is turning to provide both cooling and lubrication for the system. The source of the additional metals in stern tube packing gland effluent is likely mechanical system wear or lubricants used in the vessels' power trains.

Although not directly sampled, EPA gathered existing information from the literature to characterize discharges from antifouling hull coatings. Antifouling hull coatings are specialized paints and other coatings intended to retard the growth of algae; weeds; and encrusting organisms, such as barnacles and zebra mussels, on the underwater portion of vessel hulls. The coatings retard growth by continuously leaching biocides into surrounding waters. The most commonly used biocide is cuprous oxide. The biocide enters the water column through both passive leaching and underwater hull cleaning and can accumulate in the water of poorly flushed boat basins to levels that may harm marine life. For example, the leaching of copper from antifouling hull coatings used on recreational boats is a major source of copper pollution in several large boat basins in Southern California. Copper from antifouling coatings has created documented water quality concerns in areas such as the Chesapeake Bay; Port Canaveral, Florida; and several harbors in the state of Washington.

Environmental Impacts

Using the results obtained from this study, EPA modeled a large hypothetical harbor to evaluate the environmental impacts from the nine above mentioned vessel discharge types that EPA sampled. The screening-level model indicated that the study vessels' discharges would not, in themselves, exceed the aquatic life or human health NRWQC; however, the model did not account for background loadings. Certain pollutants (e.g., total arsenic, dissolved copper) are more likely to contribute to a water quality criterion being exceeded under real-world conditions in large-scale water bodies. Additionally, many pollutants present in the vessel discharges were at concentrations that exceed an NRWQC at end of pipe; therefore, they have the potential to contribute to an environmental effect in the receiving water on a more localized scale. Based on the study results and literature reviews, EPA believes that total arsenic and dissolved copper represent the greatest environmental concern in vessel discharges, and that they are more likely than other pollutants to contribute to exceedances of water quality standards. This is especially true if there are other sources of these pollutants (e.g., stormwater runoff) or high concentrations of vessels in confined waters, or the receiving waters already have high background concentrations.

Other notable pollutants of concern were found in fish hold effluent from fishing vessels. These pollutants include total phosphorus, BOD, COD, reactive nitrogen compounds, and pathogens. These pollutants can exacerbate eutrophication in bays and estuaries, leading to poor surface water quality.

Analysis of Applicable Regulations

This report to Congress includes EPA's analysis of existing laws and treaties that apply to vessels and their discharges. This analysis describes numerous domestic laws, including the Act to Prevent Pollution from Ships (APPS); the Clean Water Act (CWA); the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); and the Organotin Antifouling Paint Control Act (OAPC). It also summarizes key elements of several international treaties, including the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), the International Convention on the Control of Harmful Anti-Fouling Systems on Ships, the International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), and the International Convention on Oil Pollution, Preparedness, Response and Cooperation (OPRC). The purpose of this analysis is to summarize these existing regulations and international obligations and examine the extent to which these discharges are subject to these obligations.

Conclusion

Some vessel discharges from commercial fishing vessels and commercial vessels less than 79 feet in length may have the potential to impact the aquatic environment and/or human health. As noted above, using the results obtained in this study, EPA modeled a large, hypothetical harbor to evaluate how the nine vessel discharge types EPA sampled may impact water quality. Based on this evaluation, EPA determined that the incidental discharges from study vessels to a relatively large water body are not likely to solely cause an exceedance of any NRWQC. This finding suggests that these discharges are unlikely to pose acute or chronic exceedances of the NRWQC across an entire large water body. However, since many of the pollutants present in the vessel discharges were at end-of-pipe concentrations that exceeded an NRWQC, there is the potential for these discharges to contribute a water quality impact on a more localized scale. The study results indicate that total arsenic and dissolved copper are the most significant water quality concerns for the study vessels as a whole, and that they are more likely than other pollutants to contribute to exceedances of water quality criteria. This is especially true if there are high concentrations of vessels in confined waters or other sources of pollutants or the receiving water already has high background concentrations.

Like an individual house in an urban watershed, most individual vessels have only a minimal environmental impact. As in urban waters, however, the impacts caused by these vessels are potentially significant where there is high vessel concentration, low water circulation, or there are environmentally stressed water bodies. Targeted reduction of certain discharges or pollutants in discharges from these vessels in waters sensitive to the introduction of pollutants from vessels may result in important significant environmental benefits to those waters.